Takasi YAMAZAKI*: **Embryological studies in Ebenales (2)**

山崎　敬*: カキノキ目の胚発生 (2)

(Pl. XXV)

Symplocaceae

The embryology in the Symplocaceae has not been sufficiently studied up to date. I report the embryology of *Symplocos chinensis* in this paper. The material was collected from Kami-saginomiya, Nakano-ku, Tokyo Pref., and fixed in formalin-acetic-alcohol.

Ovule and embryo sac The ovary is bilocular and has 4–6 anatropous ovules in each locule on an axile placenta (Pl. XXV: 1). The ovule is unitegumic and tenuinucellate. The integument consists of 6–9 cell layers. In mature embryo sac stage the innermost layer of the integument is made of thin cells arranged regularly. A single hypodermal archesporial cell differentiates into the young nucellus (Fig. 1: 1). The nucellus represented by a single layer of cells degenerates early. The archesporial cell functions directly as the megaspore mother cell and divides giving rise to a linear tetrad of four megaspores (Fig. 1: 5). The chalazal one functions and gives rise to the embryo sac. The functional megaspore undergoes three nuclear divisions leading to the formation of two, four and eight-nucleate gametophyte stages (Fig. 1: 2 and 3). The mature embryo sac is filiform in shape and shows the usual organization (Fig. 1: 4). Three antipodal cells lie side by side and degenerate before the fertilization.

Formation of the endosperm The endosperm is the cellular type. The first division of the primary endosperm nucleus takes place with a transverse wall to form a micropylar and a chalazal chambers (Fig. 1: 7). The chalazal one undergoes transverse division (Fig. 1: 8). Subsequent divisions are irregular and all the cells divide and contribute to the endosperm formation (Fig. 1: 9 and 10, Fig. 2: 12). The mature endosperm is an ovoidal body

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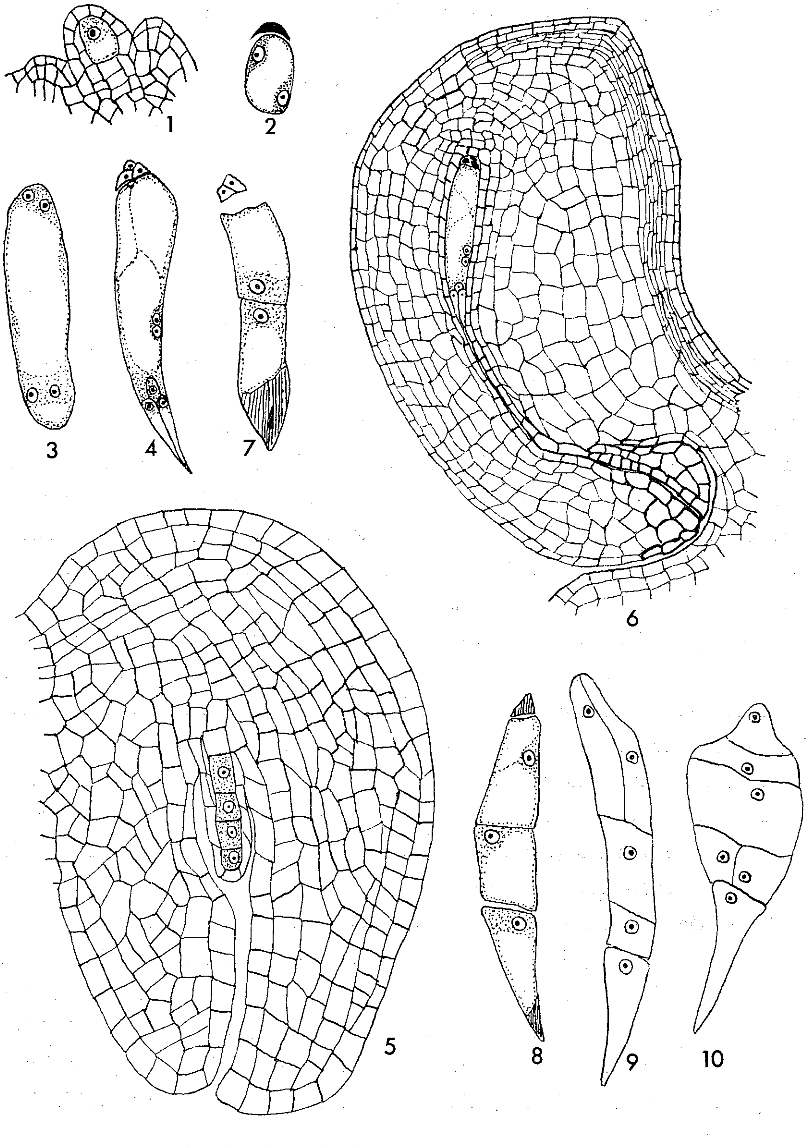


Fig. 1. *Symplocos chinensis.* Stages in development of the embryo sac and endosperm. 1-4: ×350. 5: ×200. 6: ×180. 7-8: ×350. 9-10: ×160.

and consists of many cells containing no starch but much oil (Pl. XXV: 6). The endosperm haustorium cannot be found anywhere.

Embryogeny After the fertilization, the zygote elongates. Most of the cytoplasm remains near the top of the elongated cell and the nucleus is also located in this position (Fig. 3: 1). The first division is transverse resulting in an apical cell *ca* and a basal one *cb* (Fig. 3: 2). The basal cell *cb* undergoes a few transverse divisions to form the uppermost tier *m* and the basal cells *ci* (Fig. 3: 4 and 5). The cells *ci* contributes to the formation of the suspensor *s*. The tier *m* differentiates as the apical part of the root cap *co*. The upper cell *ca* divides longitudinally to form two cells and then transversely to from two tiers of two cells each *cc* and *cd* (Fig. 3: 4). Then

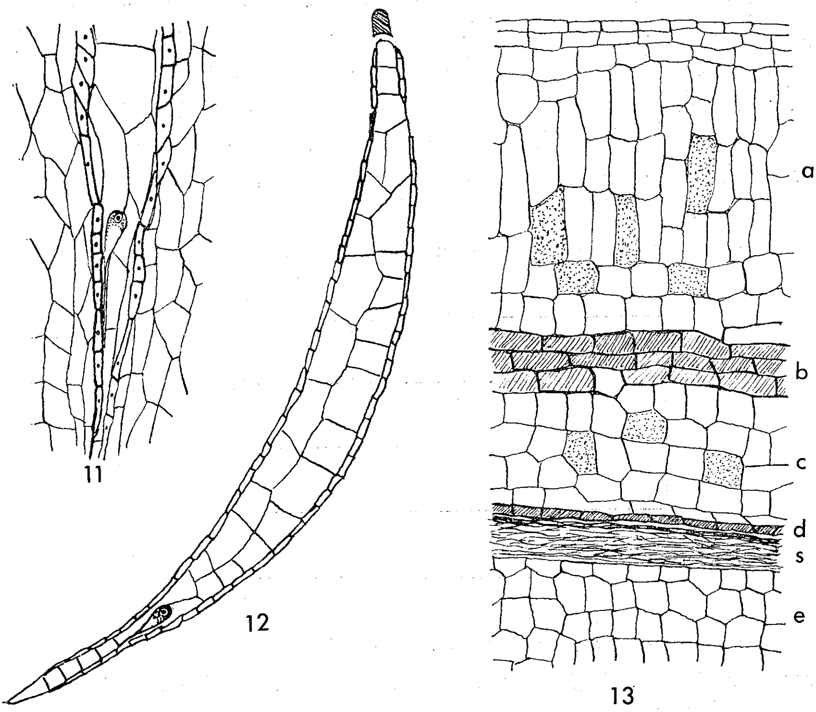
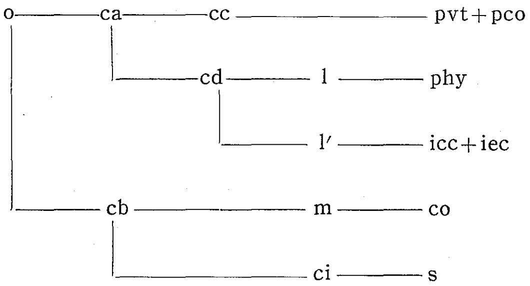


Fig. 2. *Symplocos chinensis*. 11: Young stage of the seed showing regularly arranged and thick walled cells of the innermost layer of the integument. ×140. 12: Young endosperm ×70. 13: A part of the fruit showing the thin seed coat and thick pericarp. The dotted cells contain tannin. ×170. a, Exocarp. b, Mesocarp. c, Endocarp. d, The innermost layer of the pericarp. s, Seed coat. e, Endosperm.

longitudinal divisions in both tiers result in two tiers of four cells each (Fig. 3: 6). Four cells of the upper tier *cc* are divided by tangential walls to form outer and inner daughter cells (Fig. 3: 8). The outer daughter cells are divided only by anticlinal walls and give rise to the epidermal initials. The divisional sequence of the inner daughter cells is not definite, whether longitudinal followed by transverse or in the reverse order. Thus formed inner daughter cells of the tier *cc* differentiate to be the mother cells of the cotyledonary initials and the elements which constitute the stem apex from inside. Four cells of the lower tier *cd* are divided by longituninal walls to produce the outer and inner cell layers (Fig. 3: 8) and divide transversely to produce the upper and the lower tier *l* and *l′* (Fig. 3: 9 and 10). The upper tier *l* repeats periclinal and anticlinal divisions and produces the plerome and periblem initials (Fig. 3: 11 and 12). The lower tier *l′* divides comparatively slowly to form the initials of the central cylinder of the hypocotyl *icc* and the initials of the root cortex *iec* (Fig. 3: 13, Pl. XXV: 3–5). The mature embryo which is strongly curved and filiform in shape comprises two small cotyledon *pco* and a elongated hypocotyl *phy* (Pl. XXV: 6).

The process of the embryo formation of *Symplocos chinensis* is as follows:



Seed In the flowering stage the ovary has 4–6 ovules, but only one (rarely two) ovule is developed (Pl. XXV: 2) and the ripe fruit has generally one seed. In mature seed the integumental cells are crushed and form the seed coat of thin membrane (Fig. 2: 13, s). The endosperm occupies the entire seed cavity being oval in shape and contains abundant oil. The cells of two or three middle layers of the ovary wall develop lignified thick-

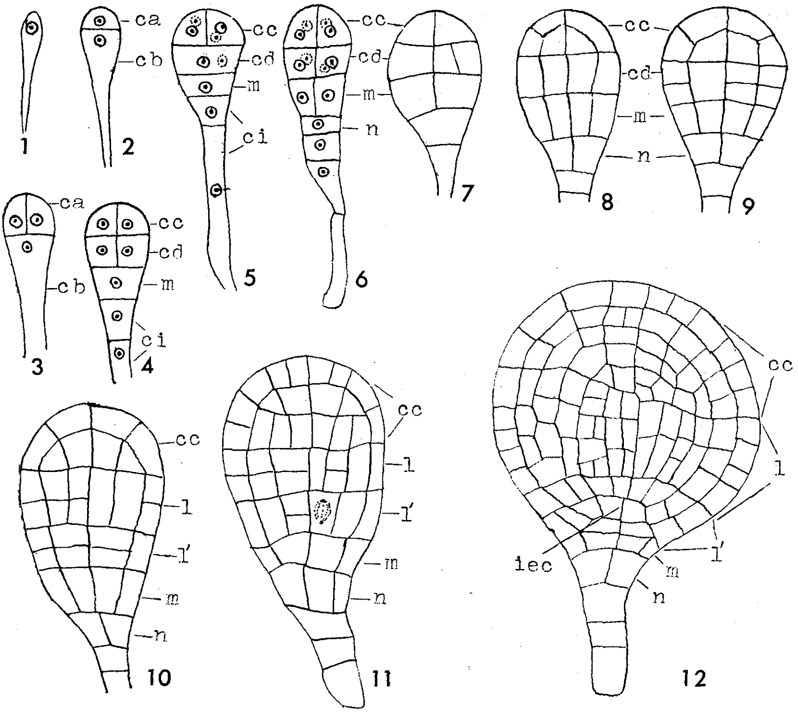


Fig. 3. *Symplocos chinensis*. Stages in embryo formation. ×350.

enings with a brown tint and look like a seed coat. The ovary wall is differentiated into three zones (Fig. 2: 13): 7-8 celled layers of exocarp consisting of enlarged fleshy cells (a), two or three layers of mesocarp consisting of lignified thickened cells (b) and 5-6 celled layers of endocarp consisting of hyaline cells and some tannin ones (c). A innermost layer of the pericarp consists of small cutinized brown cells (d).

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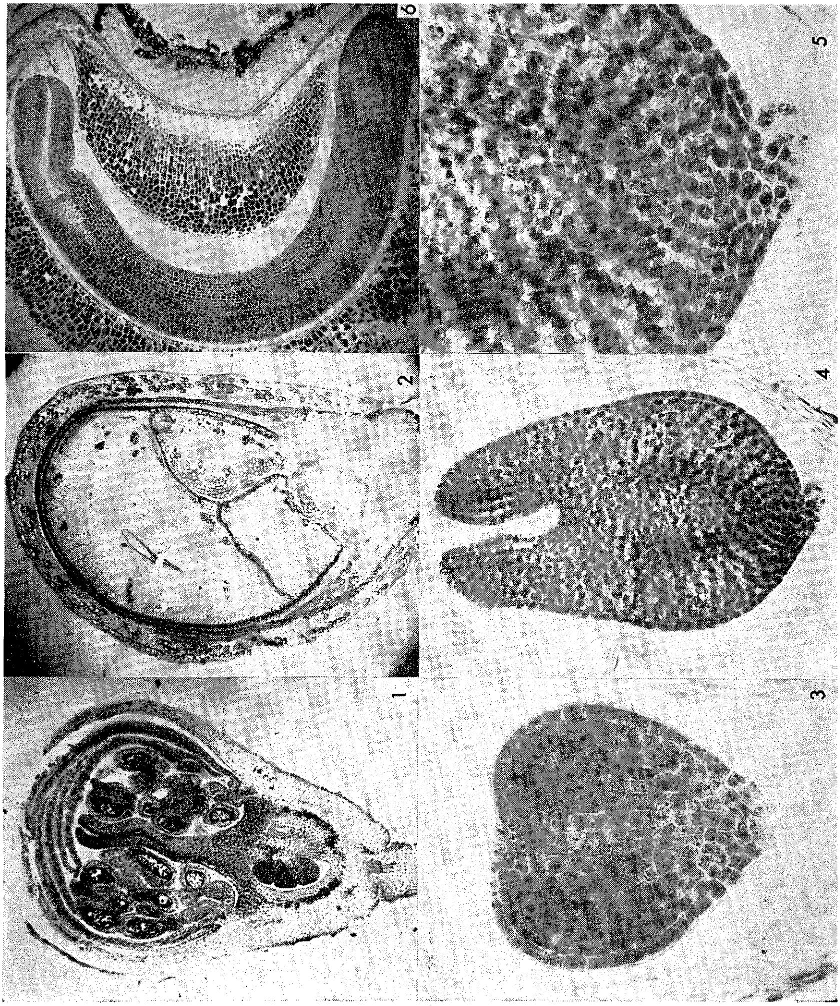
ハイノキ科はエゴノキ科に近縁で Bentham & Hooker は同一科としてあつかっている。外部形態の上からは両者を区別する重要な性質はみいだせない。しかし種子形成の上からみると，両者の間には明らかな違いがある。ハイノキ科の胚珠は１枚の珠皮をもち，エゴノキ科が２枚の珠皮をもつのと異る。胚形成は，エゴノキ科と同じく

Chenopodiad type であるが，原根層は，エゴノキ科は cd 層の上部細胞群から分化するが，ハイノキ科では cd 層の下部細胞群から分化する。また成熟した胚の形は著しく湾曲した細長い胚軸をもち，子葉が小さいが，これもエゴノキ科の胚と著しく異っている。エゴノキ科の種子は種皮がよく発達し，堅い石細胞からなる厚い種皮は，果皮から容易にはなれるが，ハイノキ科では種皮はごく薄く，中果皮が堅くなって種子を包み，肉質の外果皮をとりさってでてくる，種皮のようにみえるものは，中果皮の発達したものである。

Explanation of Plate XXV

Symplocos chinensis 1: Longitudinal section of the young flower. ×40. 2: Young fruit having one developing seed and two degenerated ones. ×20. 3: Young embryo. ×225. 4: Young embryo. ×120. 5: Young embryo showing initials of the root cortex and the central cylinder, same with fig. 4. ×350. 6: Mature embryo. ×20.

□津山　尚・浅海重夫編: **小笠原の自然** The Nature in the Bonin Islands。原色写真228頁，解説271頁。広川書店，昭和45年10月，9,800円。1968,1969年の2回にわたる，東京都及び厚生省による，小笠原諸島自然公園調査団の成果を中心に，同島の自然を紹介したものである。戦後のまとまった報告としては，東京都・厚生省の小笠原諸島自然景観報告書（1969,1970）と文部省・文化庁の小笠原の自然（1970）とがあるが，これらは学術報告書である。一般向を目的として書かれたものは，戦前もふくめて始めてである。気候，海洋，地形・地質，植物，陸上動物，海中生物，魚類，火山列島・西之島，人文，などの各章にわかれ，原色写真のほかにも豊富な図版，白黒写真があってくわしい解説書であるが，同時に戦後20数年，全く人手が入らずに放置されていた小笠原を充分に記録していることは貴重である。現在の小笠原の調査はギンネムの密林や，殆んど歩行不能のタコズルの草原を切開きながら行うので，なかなか大変である。特に母島の乳房山から石門山にかけての調査は，水をもとめる所もない熱い熱帯の尾根を，道を作りキャンプしながらの調査は並大抵のものではなかったと思う。私も津山氏等の調査の一週間後，母島で氏等の作られた道を利用させていただいたが，それでも大変であった。水場まで往復2時間の道を幾度も上下し，方角もわからない密林に道をつけキャンプを設営して研究を援助された，調査団員の方々の努力が，本書のささえになっているのである。解説と原色写真とが別冊になっているのは，利用するものにとっては不便であり，本をながめる楽しみも半減するのは残念である。動物の原色写真はみごとであるが，それにくらべると植物にはやや見劣りするものが目立つのは，苦労の多い調査なのでやむをえないことと思うが，植物を中心として利用するものには惜まれる。　（山崎　敬）



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